

56 MHz SRF Upgrade Status FOR sPHENIX

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On behalf of the RF/SRF Groups

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BROOKHAVEN SCIENCE ASSOCIATES

Overview

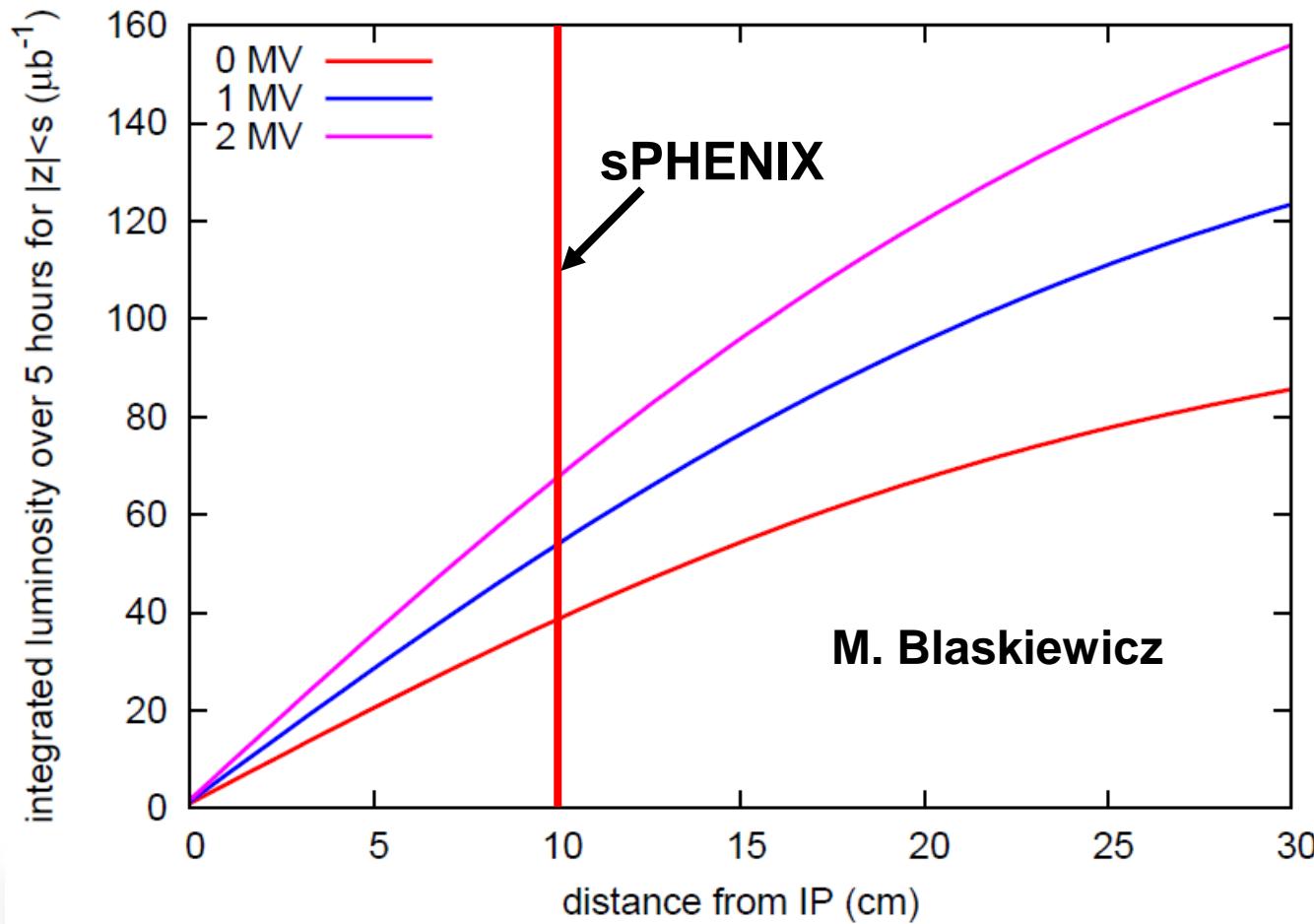
- Purpose
- 56 MHz System
- sPHENIX Changes
- Status Update
- Future Schedule

56 MHz Quarter-Wave Resonator



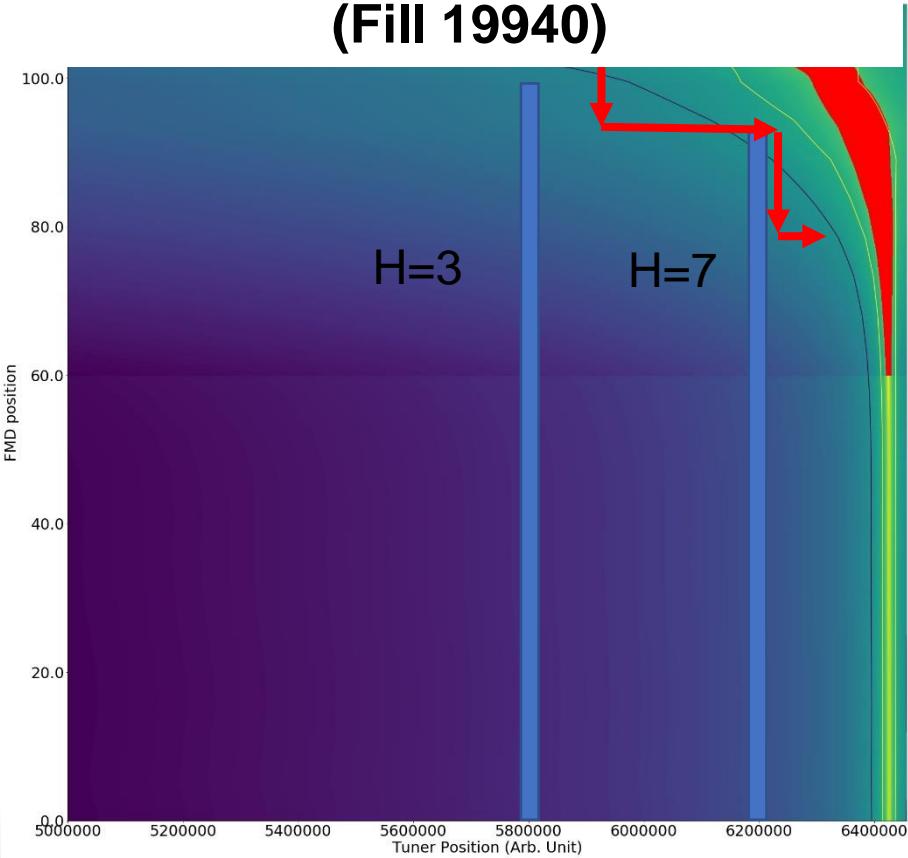
sPHENIX Impact

sPHENIX Performance with 56 MHz QWR

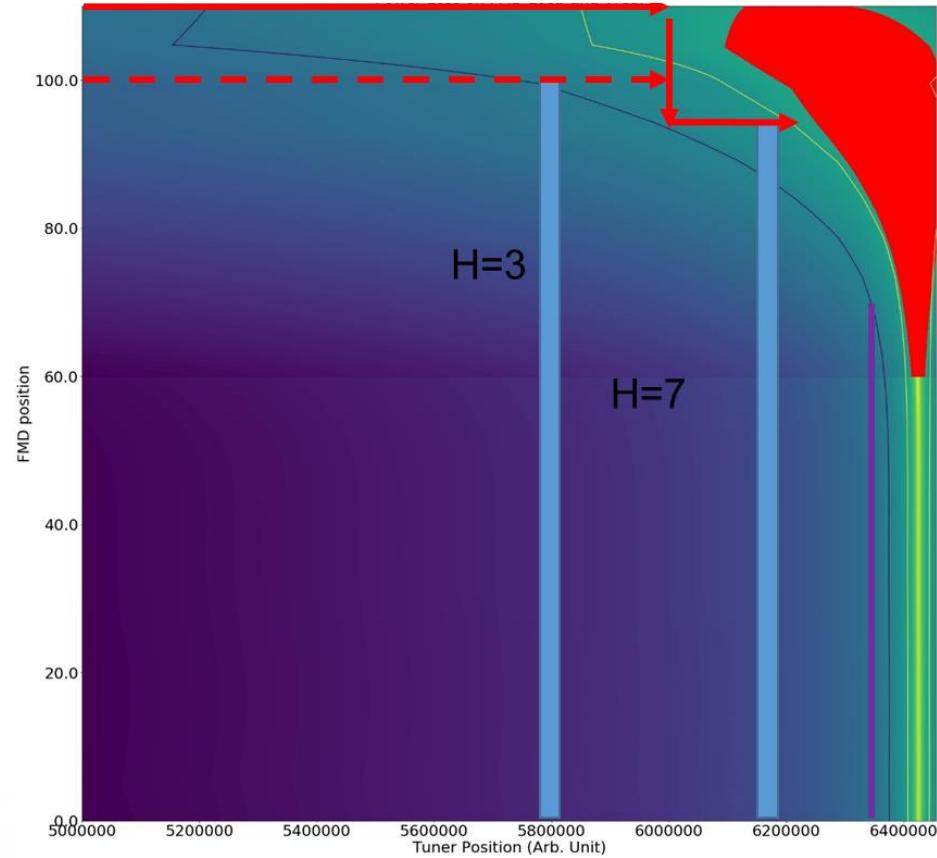


56 MHz Operation: Power Loss on FMD Loop and V_{real}

**Simulated Operation During Successful RHIC Run @ 1 MV
(Fill 19940)**



Planned Operation For sPHENIX Run @ 2 MV



S. Polizzo, Presentation @ 2016 MAC Review



QWR56 - 10/15/2020

T. Xin, S. Polizzo & M. Blaskiewicz



56 MHz Cryomodule

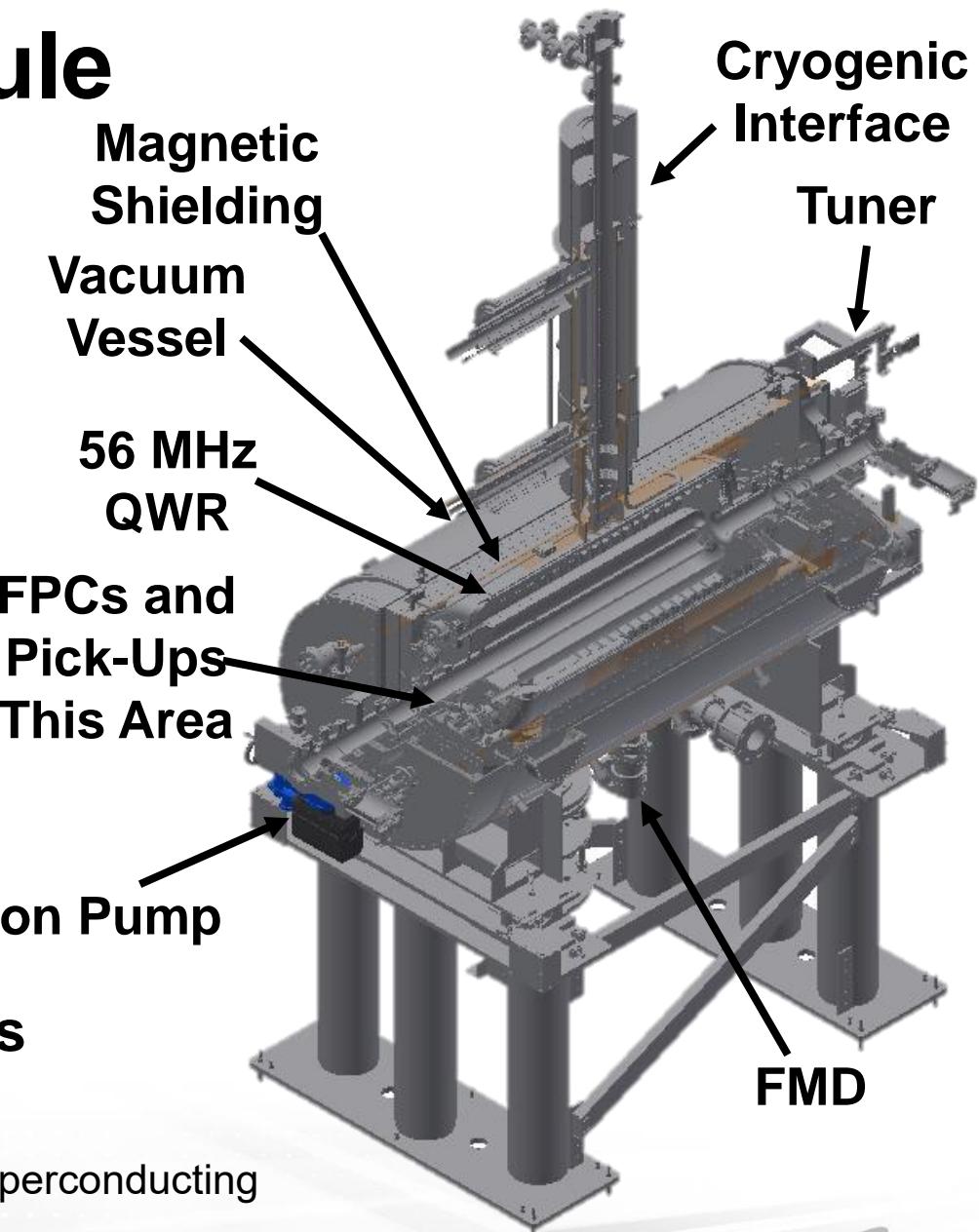
What do we need?

- Cavity operation > 2 MV
- Fundamental Mode Damper (FMD) ~ 90 kW, and HOM Damper
- Fundamental Power Couplers (FPCs) ~ 3 kW

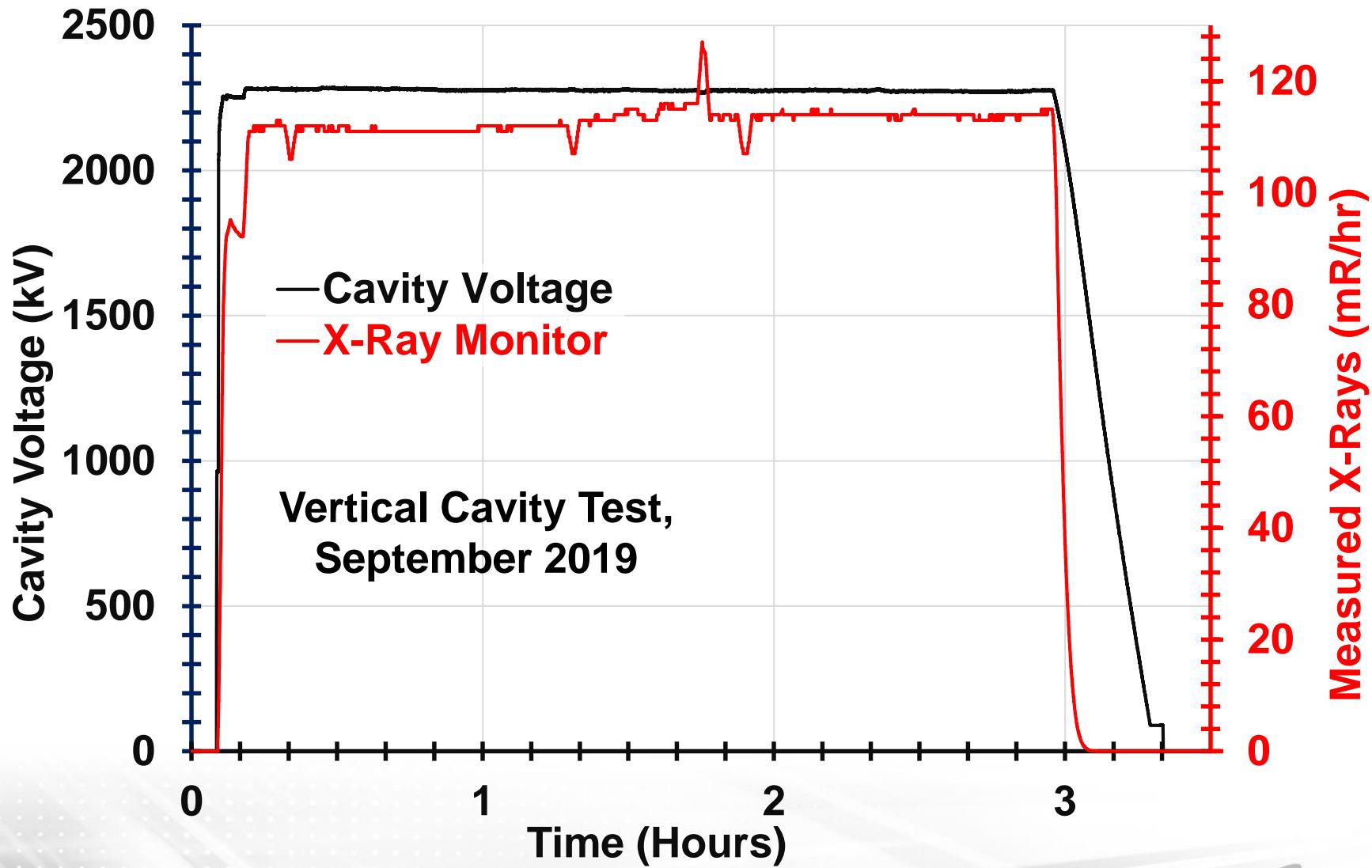
Refit systems:

- Low-Particulate SRF Assembly
- Cryogenic Cooling
- Redundant Pick-Up Probes
- Vacuum Pumping

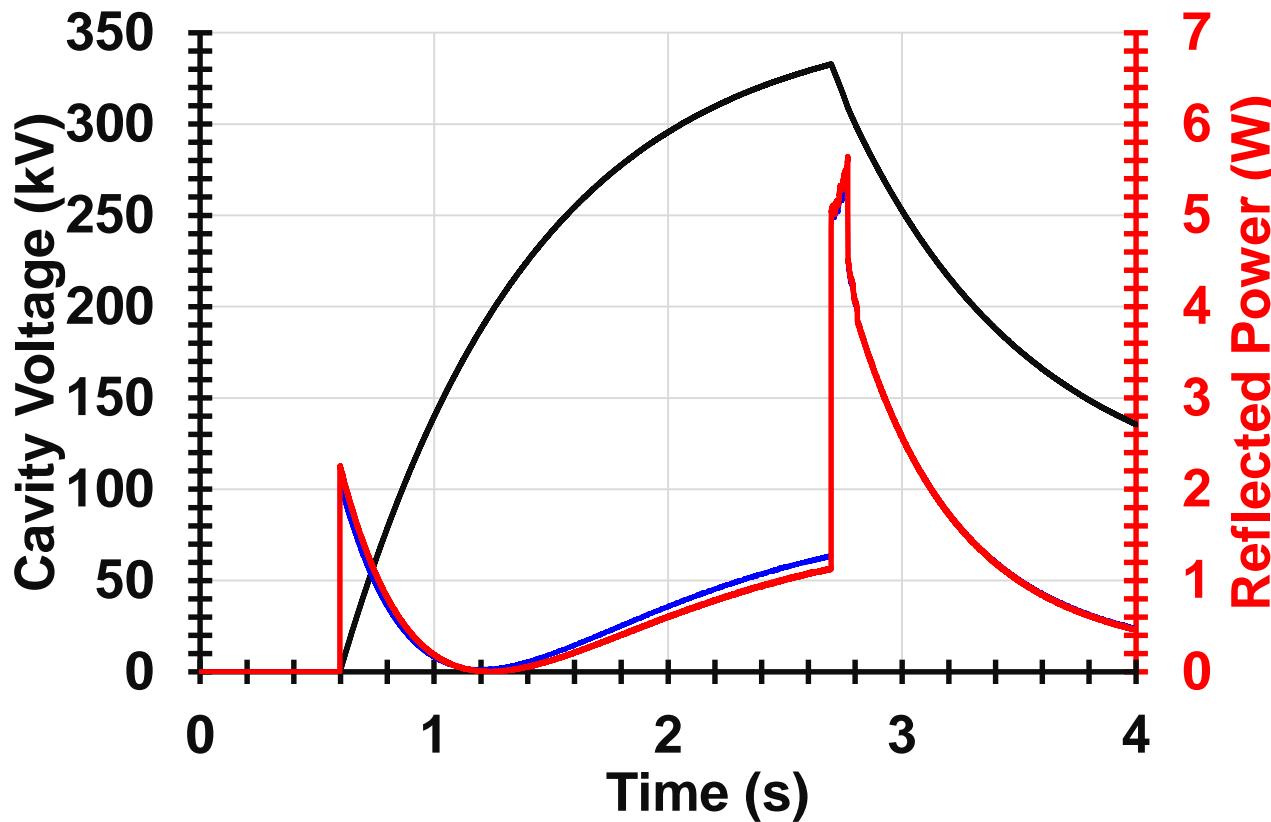
Q. Wu et al, "Operation of the 56 MHz superconducting rf cavity...", PR-AB 22, 102001 (2019)



Cavity Operation > 2 MV?



Cavity Vertical Test - II



Loaded $\tau_V = 26.58$ s

$Q_L = 4.7 \times 10^9$

Residual Surface
Resistance ≤ 1.5 n Ω

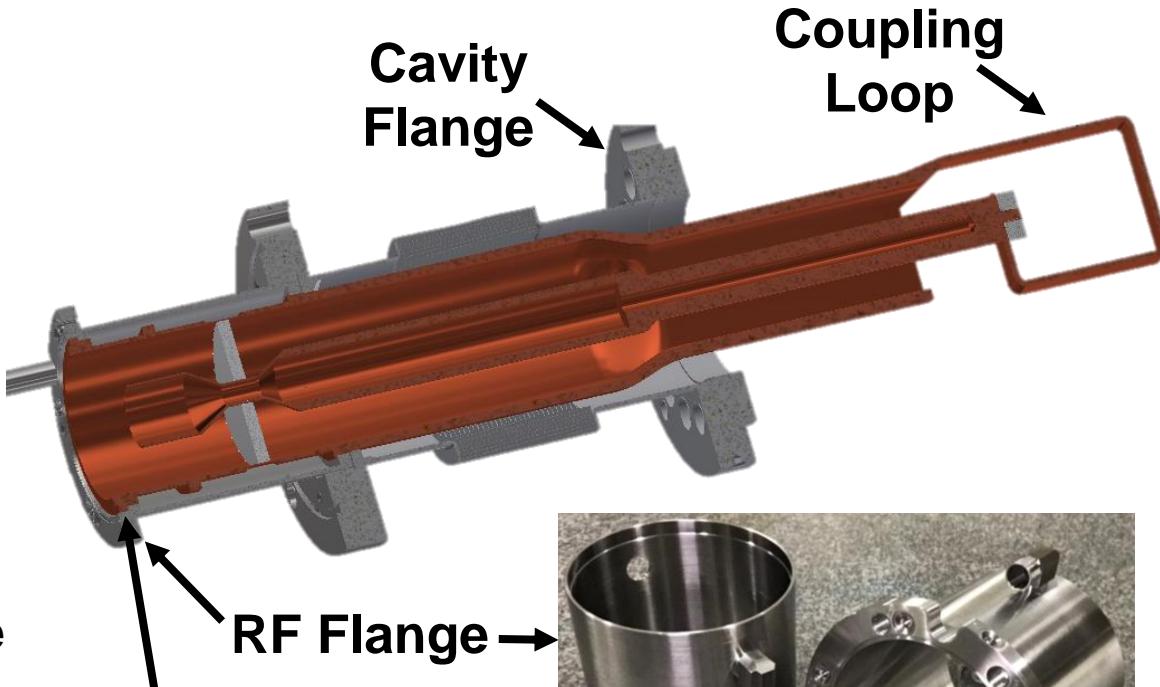
$$\beta = \frac{1}{2 * \sqrt{\frac{P_f}{P_e^{inst}} - 1}}$$

$$Q_0 = (1 + \beta) * Q_L$$

Cryomodule test will have variable coupler and can check this measurement.

56 MHz FMD

- Transmission line size increased to maximum allowed by cavity Nb construction.
 - 1-5/8" → 3-1/8" coax
 - Thermal cooling enhanced
 - Increased interface areas for thermal transfer.
 - Eliminated joints, pressed contacts in the beam volume, and nickel coatings.
- Parts in fabrication now and testing is planned for early next calendar year.



RF Transmission Line



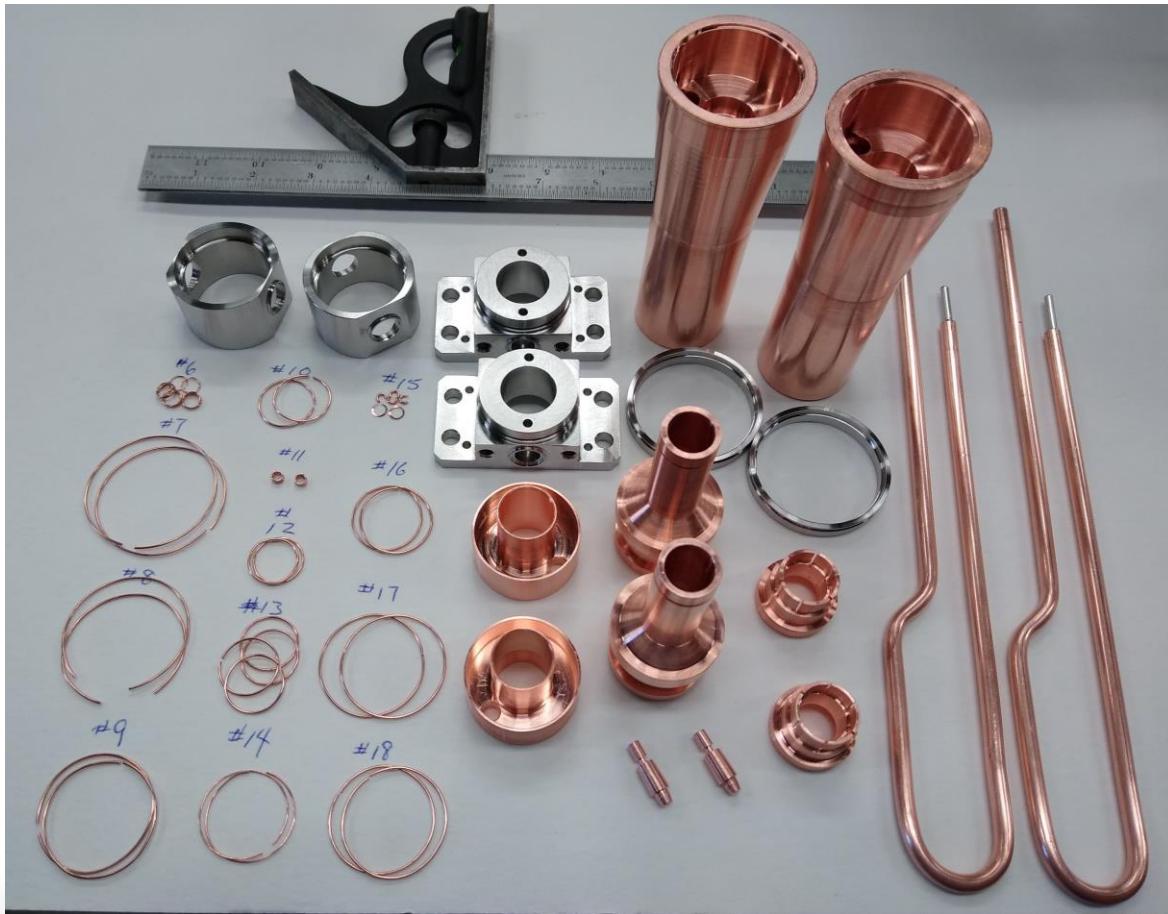
Loop Bending Test



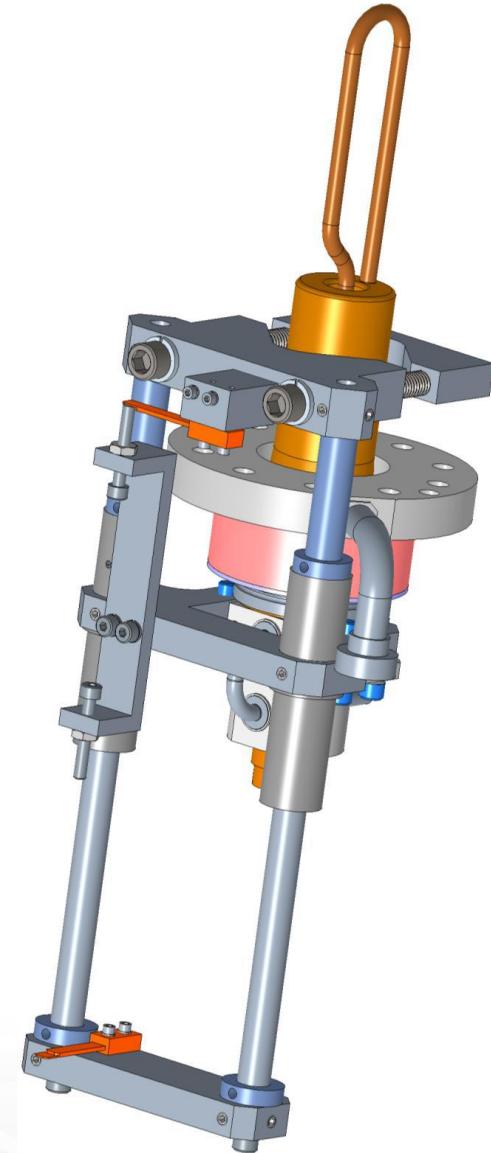
Fundamental Power Couplers

FPC Model

FPC Parts



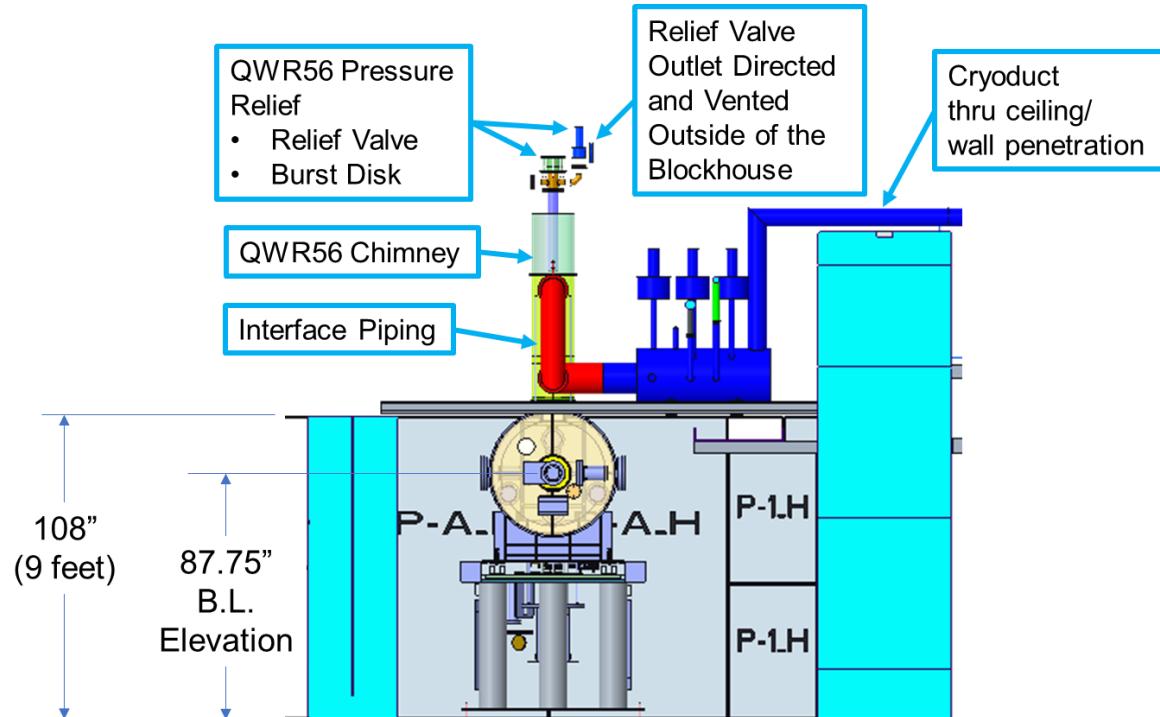
D. Holmes



New Cryogenic Cooling & Thermometry

- New cryogenic distribution system for offline testing in BLDG 912.
- New cryogenic cooling requirements for cryomodule.
- New thermometry for system monitoring.

New 912 Cryogenic Layout in ERL Test Cave

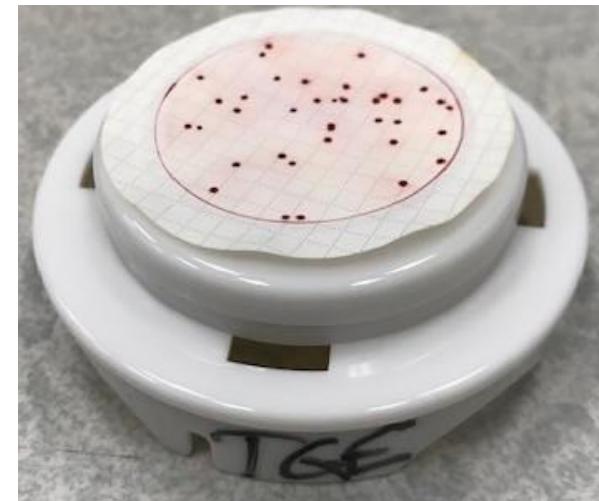


V. Soria, T. Tallerico, N. Nilsson, P. Orfin & R. Than

SRF Cleaning

- Bacteria contamination of ultra-high purity water system.
- High pressure rinse system rebuild is underway and expected to finish in February/March 2020, in time for 56 MHz cavity processing.
- Still able to meet sPHENIX schedule.

High Pressure Rinse System Bacteria Culture



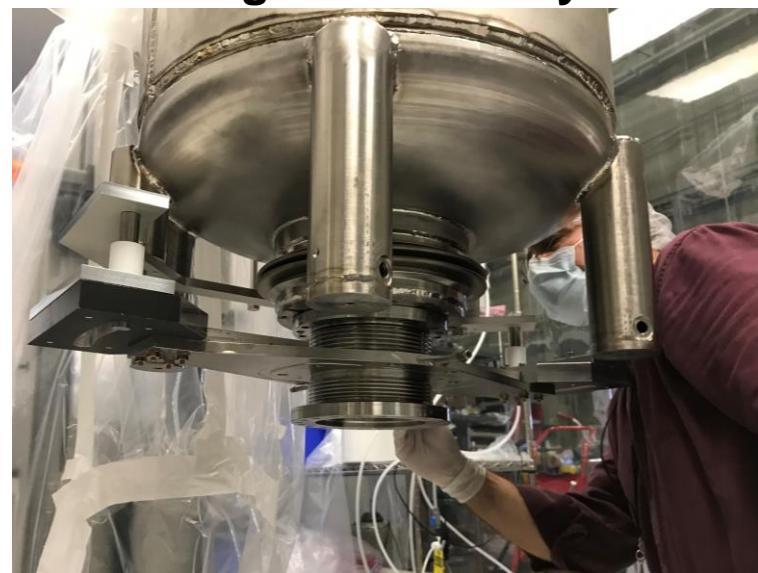
Bacterial Corrosion of High-Pressure Pump Cylinder



56 MHz QWR Schedule & Challenges

- To finish the 56 MHz QWR cryomodule:
 - Fabricate 2 fundamental power couplers, fundamental mode damper and other components. (Q1-Q2 FY2021)
 - Repair and reclaim SRF clean room after floor buckling. (Finished Q4FY2020).
 - Recover SRF high pressure water system for SRF cavity processing. (Q2FY2021)
 - Finish 56 MHz QWR SRF beam-line clean assembly. (Early Q3FY2021)
 - Finish 56 MHz QWR cryomodule assembly. (Q3FY2021).
 - Offline test 56 MHz QWR cryomodule in old ERL Test Cave. (Q4FY2021)
- Major tasks:
 - Finish fabrication and testing of fundamental power couplers.
 - Finish fabrication and testing of fundamental mode damper
 - Restart low-particulate cleaning operations.

New Tooling for Assembly of Tuner



New Pick-Up Probe



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